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New insights into Levantine copper trade: analysis of ingots from the Bronze and Iron Ages in Israel

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ABSTRACT

The close association of metal ingots to the smelting operation and hence to the ore deposit makes them good candidates for provenance studies which in turn can be used for reconstructing paths of metal trade. A unique group of ingots from Hazor, Israel and two ingot groups retrieved during underwater explorations off the Carmel coast (Israel) were subjected to microstructure, chemical and lead isotope analysis. Ingots from Timna, Bir Nasib and Deir Alla, previously studied, were also subjected to bulk chemical and lead isotope analysis (LIA). The results enabled us to follow changes in the supply of copper to sites of this part of the Levant between two main copper producers: Cyprus and the Arabah (Timna and Faynan). The analyses showed that two of the ingot assemblages correspond to two different phases of Cypriot copper exportation in the second millennium BCE. The earlier phase, identified here for the first time, dated to the Middle Bronze Age II – Late Bronze Age I, consisted of trade in black copper in the form of relatively small plano-convex ingots, as suggested by the evidence from Hazor. The later phase, dated to the Late Bronze Age II, during which Cypriot copper was traded in the form of large oxhide –shaped ingots, is well-known and is evidenced by oxhide ingots recovered off the Carmel coast. A third assemblage from Neve Yam, off the same coast, consisting of 54 ingots of similar shape and composition, is identified here as the hitherto unknown product of the large-scale operations at Faynan in the Iron Age.

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1. Introduction

1.1. Copper ingots

Copper ingots are rare in the archaeological record and when found, they do not always originate from well-defined stratigraphy. However, they contain invaluable information by forming the closest link in the 'operational chain' with smelting procedures, and hence the ore sources. Ingots are perhaps the best sources of information on the ore source through chemical and isotopic analysis. This information, coupled with their find locations and contexts, can shed light on copper trade networks during different times in history.

The earliest group of copper ingots known from Israel was found in Central Negev highland sites dated to the Intermediate Bronze Age[1] (henceforth 'IBA', c. 2400–2000 BCE). The ingots were bar-shaped and small (10–12 cm in length). Chemical and lead isotope analyses showed that they were likely made of unrefined iron-rich 'black copper' that originated from Wadi Faynan, Jordan (Segal et al., 1999, Segal et al., 1996-1997). This was later confirmed by matching moulds found in the contemporary production site of Khirbet Hamra Ifdan, located within the Faynan area (Levy et al., 2002). No ingots were reported from Early or Middle Bronze Age contexts.

Six cargo assemblages containing copper, lead and tin ingots, roughly dated to the Late Bronze Age (henceforth 'LBA', c.1550–

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[1] Previous terminology for this period is the Early Bronze Age IV (henceforth 'EBA') or MBAI; the current term most commonly used is IBA. This and other periodization and chronology followed in this article are based on Stern (2008).

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1200 BCE) were retrieved during underwater explorations of shipwrecks off the Carmel coast (see Fig. 1 Galili et al., 2011, Galili et al., 1986). Of these, two complete copper oxhide ingots and fourteen tin ingots from the site of Hishulei Carmel were analyzed by N. Gale (Galili et al., 2013). Fifty four loaf-shaped copper ingots were recovered in an anchorage SW of Kibbutz Neve Yam (Fig. 2, Galili, 1984; Galili et al., 2011; Galili and Sharvit, 1999, Fig. 202: Assemblage 2). The assemblage included several single-hole stone anchors with round tops (Galili and Sharvit, 1999; Fig. 15). These are dated generally to the 2nd and 1st millennia BCE and thus provide a chronological framework for the ingots. Nine ingots were sampled for this study (Table 1: 8–16, Fig. 2). Another assemblage discovered some 1.4 km north of Hishulei Carmel near Kefar Samir (north) included six ingots fragments along with several asymmetric single-hole stone anchors weighing 80–120 kg each (Fig. 3, Galili, et al., 2011: 67, IAA survey map No. 7, Site 36). All six were sampled for this study as was a metal spill (YAM 8), which was found among the fragments (Table 1: 1–7, Fig. 3). Two of the six (YAM 4 and YAM 6) may have been handles which broke off oxhide ingots. One appears to be the fragment of a large slab ingot (YAM 5) and three others have an unidentified shape. Note too that some 500 m to the south, another cargo was found (Kefar Samir south). It included five single-hole stone anchors, several tin and lead ingots and a Bronze Age sickle sword (Galili and Sharvit, 1999, Fig. 25; Raban and Galili, 1985).

Past and present excavations in Hazor yielded several copper ingots. Three bun-shaped copper ingots were found in the gate tower in Area P during the James A. de Rothschild Expedition, in a Late Bronze Age I–IIA context (c. 1550–1300 BCE). They were studied by I. Roman and published in Hazor V (Ben-Tor and Bonfil, 1997: 359, Photo V.12, Fig. V.2A: 1–3, Roman, 1997). In the course of the Selz Foundation Hazor Excavations, directed by A. Ben-Tor, six additional ingots were discovered in Area A. All six were analyzed for this study and are published here for the first time (Table 1: 22–27, Fig. 4, METB67 is not shown). Only one of the six (METB56) was found in a well-dated context (Table 1: 26) on a pavement (L4099) dated to the LBAI, north of the Southern Temple. The ingot is plano-convex, similar in shape but smaller than the ingots found in the gateway of Area P and roughly contemporary with them. Significantly, additional metallurgical debris was found in Area A, in the central monumental building (Palace/Temple 7050) and in the courtyards surrounding it (Yahalom-Mack et al., 2014). Another

Fig. 1. Map of sites mentioned in the text.

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